IceCube Software

The Frame/Stream/Stop Conceptual Model

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This document describes the Frame/Stream/Stop conceptual model, which is the basis for the FAYE program that is used in IceCube to manage its Online filters and process its data when it comes into the Data Warehouse.

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1.0 Introduction

1.1 Purpose

The purpose of this document is to describe the Frame/Stream/Stop conceptual model so that both users and programmers can understand the expected behavior of the FAYE program. This should enable users to easily understand the organization and control structures they need to run the program. It should also

1.2 Scope

The scope of this document is...

1.3 References

The following references are used throughout this document.

[CDJ97] Design and Implementation of the CLEO III Data Access System, presented as A380 at CHEP97 (http://www.desy.de/chep97) by Christopher Jones

1.4 Definitions and Acronyms

FAYE: The “Frame AnalYsis Executable” that is a Java implementation of this conceptual model.

Frame: an electronic picture of the experiment at a given instant of time of, or over a brief window in, time.

HEP: High Energy Physics.

Record: A set of conceptually related data that are connected to a given instant of, or brief window in, time.

Stop: The combination of the Stream and time that caused a Frame to be supplied to the user.

Stream: The set of all Records of a single type.

1.5 Overview of this Document

The next section...

2.0 Background

The aim of the Frame/Stream/Stop model is to provide a conceptual framework in which data can be analyzed. This model was developed at CLEO [CDJ97] as the basis for its new object oriented analysis framework.

Existing HEP analysis frameworks at the time were “Event” oriented, i.e. the user code was handed, in sequence, the data for each Event within a set of Events. However some troublemakers (we know who you are) pointed out that while this was fine and dandy for 95% of the physics analysis that went on there was a significant number of other analyses which where interested in other aspects of the data, e.g. HV readings, geometry changes, etc. This lead to the design team returning to the drawing board and eventually coming up with the Frame/Stream/Stop model which generalized the standard Event-centric model so that any portion of the data taken by (or derived from) an experiment could be made the center of an analysis.

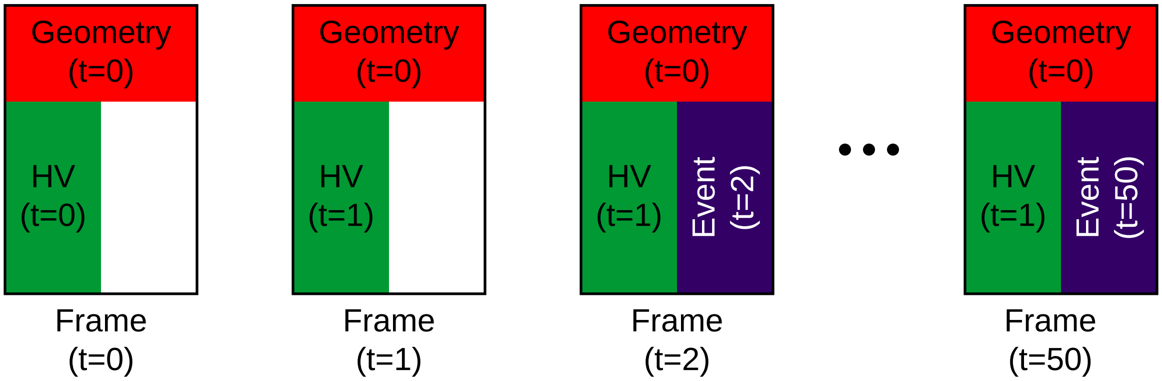
3.0 Fundamental Concepts

The cornerstone of the Frame/Stream/Stop model is the idea that when a users wants to analysis data, what they really want to look at is an electronic picture of the whole experiment at a given moment in, or brief interval of, time. This electronic picture is analogous to a single frame in a continuous electronic movie of the experiment. Thus all the data that goes into making up such an electronic picture is collectively called a **Frame**.

An individual Frame is made up from many different pieces of data. Some data might be common to many frame in the virtual movie of the experiment, e.g. the geometry of the experiment very rarely changes, while other data may be unique to a single Frame, e.g. the data describing a single Event. To simplify the construction, and use, of a Frame data that changes at the same time, e.g. the HV setting of an experiment often all change at the same time, can be grouped into a single unit with is called a **Record** (such an original name!). As we have already seen geometry, HV setting and "events" can all be considered different types of Records.

If we now consider how we could build up a set of Frame we can see that some Records will appear in more than one Frame while other Records appear in only one Frame. Whether a Record will be shared between more than one Frame depend on the time between the Frames rate a which the Record changes. Figure 1 illustrates these ideas.

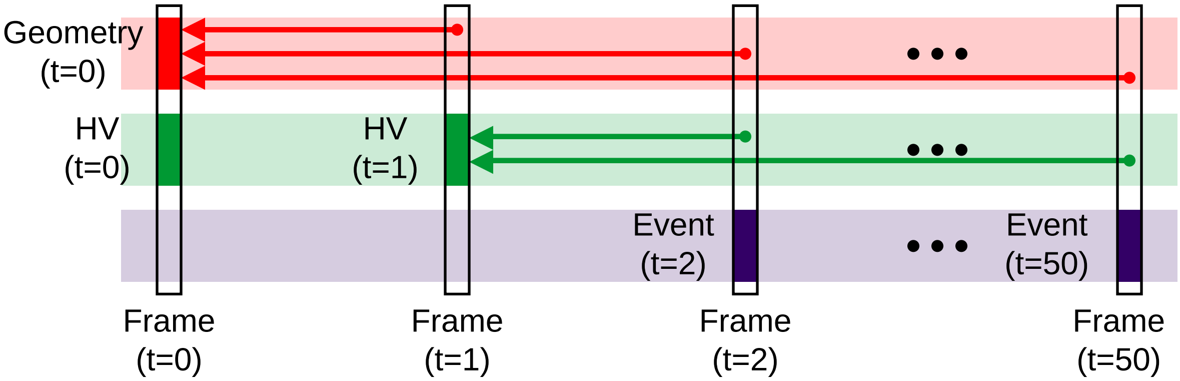
FIGURE 1: Some simple examples of Frames and Records



In this figure there are four Frames, these show the state of the experiment at the beginning (t=0), after the detector has been turned on (t=1) and the time when the first event is readout (t=2) and an example event later in data taking (t=50). This figure illustrates how the geometry Record for all four Frames is the same one, while the HV Record changes after the detector has been turned on and the Event Record, if one exists, changes in almost every frame.

The idea of one Record appearing in many frames can also be illustrated by looking at the time evolution of the Data. Figure 2 shows such an evolution for the Frames illustrated in Figure 1. In this figure Records of the same type have been grouped into a single horizontal bar. This bar represents the concept of a **Stream**, which is simply the set of all Records of a single type. Given this definition of a Stream, then a Frame can be thought of as being composed of the "most recent" Record from each Stream[1].

FIGURE 2: The time evolution of the Frames illustrated in Figure 2.



Inspecting Figure 2 should also make it clear that it only really make sense to make Frames for those times when one, or more Records change. For example a Frame at t=1.5 would be identical to the Frame at t=1. Furthermore a user of the system may not even want all those Frames. Take, for example, the following users of the model.

- A simple physics analysis that does not cache any information.

  In this case the user will only be interested in the Frame created when a new Event Record appears in the Event Stream.
- A monitoring program that plots the High Voltage.

  This program is only interested in the Frames created when a new HV Record appears in the HV Stream,
- An Event display program which builds internal representations of the detector base on its geometry.

  This program is interested in both the Frame created for new Events, to be able to display the event, and Frames created by new geometry Records, so that it can rebuild the correct internal representation.

To be able to handle the variety of user needs and make sure only the needed frames are supplied to the user for analysis the user can specify the type of Stream or Stream in

[1] Pseudo-records can be created to enable extrapolation or interpolation of data to a given point in time, but they will not be considered at this stage of the model.

which they are interested, e.g. Event, HV, Event and geometry, etc. Frame which are then supplied to the user can be tagged with the type of Stream which causes in and the time for which the Frame was created. This combination of Stream and time is call a **Stop** as this is the information that describes why the data flow was stopped and a Frame supplied to the user.

The observant reader may have already noticed that the Frame at t=0 contains two “new” Records, namely one in geometry Stream and another in the HV Stream, so the question is “which of these Streams should be used in the Stop that is supplied with this Frame?” The answer is that this Frame is actually supplied twice to the user, one time with geometry as the stopping Stream, and another time with the HV as the stopping stream. The order in which these two Stops are supplied, and any others that occur simultaneously, is defined by the experiment.

4.0 Additional User Concepts